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ABSTRACT

This curriculum guide provides materials for teachers to use in developing a course in "Exploring Aquaculture, Agriscience 282," one of 28 semester courses in agricultural science and technology for Texas high schools. This introductory course is designed to acquaint students with the growing industry of aquaculture; it includes aquaculture career development activities as well as leadership and recordkeeping opportunities. The guide is organized in three sections. The first section lists essential elements common to all vocational courses and those specific to this course. The second section lists the units and topics of instruction and suggested time allocations for each unit and topic. Listed also are the catalog numbers of corresponding curriculum materials available from the Instructional Materials Service of Texas A&M University. Topics covered in the course include the following: the nature and significance of aquaculture, the origins of aquaculture, identifying aquacultural organisms, exploring career opportunities, the use of water resources, methods of aquaculture production systems, methods of aquabusiness planning and management, planning and conducting leadership activities related to aquaculture, and conducting supervised agricultural experience programs related to aquaculture. The final section provides topic goals and objectives targeted for the completion of the topic. (KC)

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# CURRICULUM GUIDE

# FOR

# AGRISCIENCE 282 - EXPLORING AQUACULTURE

DEVELOPED

BY

INSTRUCTIONAL MATERIALS SERVICE

DEPARTMENT OF AGRICULTURAL EDUCATION

TEXAS A & M UNIVERSITY

IN

COOPERATION WITH

TEXAS EDUCATION AGENCY

DIVISION OF VOCATIONAL AND APPLIED TECHNOLOGY EDUCATION

AUSTIN, TEXAS

## ACKNOWLEDGEMENT

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USING THE

# CURRICULUM GUIDE

# FOR

# AGRISCIENCE 282 - EXPLORING AQUACULTURE

Exploring Aquaculture, Agriscience 282, is one of twenty-eight semester courses in Agricultural Science and Technology. Enrollment is open to students in grades 10 - 12 in Texas public schools. It is an introductory course designed to acquaint students with the growing industry of aquaculture. The course includes aquaculture career development activities as well as leadership and record keeping opportunities. While the primary purpose in the development of this guide is to assist the teacher in teaching the course, it may be used in other ways.

Pages 1 and 2 of this guide list essential elements common to all vocational courses. A list of essential elements specific to Agriscience 282 is on page 3.

Pages 4 - 6 of this publication list the units and topics of instruction and suggested time allocation for each unit and topic. Listed also are the catalog numbers of IMS curriculum materials that may be used in teaching the topics and satisfying the essential element requirements. More than one suggested item of curriculum materials may be listed for effective instructional presentation of some topics. Using all suggested curriculum materials meets the essential element requirements of the course.

The final section (pages 7-15) in the guide provides topic goals and objectives targeted for the completion of the topic. These should be particularly useful to the teacher in preparing lesson plans.

Each student material topic contains a list of references used in its development. Teachers wishing to cover the subject matter in more detail may acquire some of these references from Instructional Materials Service and/or from the publishers cited in the reference section of each topic.

## ESSENTIAL ELEMENTS

§75.82 Agricultural Science and Technology

(a) The elements in this subsection are common to all agricultural science and technology courses unless otherwise indicated and shall be included in each course at the appropriate level. Every school offering agricultural science and technology shall provide courses which include the following essential elements:

(1) Leadership concepts and skills. The student shall be provided opportunities to:

(A) demonstrate skills, characteristics and responsibilities of leaders and effective group members;

(B) demonstrate a knowledge of parliamentary procedure principles;

(C) plan and conduct leadership activities; and

(D) prepare for effective citizenship and for participation in our democratic society.

(2) Concepts and skills related to successful employment and/or post secondary training. The student shall be provided opportunities to:

(A) identify employment opportunities and preparation requirements in chosen fields;

(B) identify effective methods to secure and terminate employment;

(C) demonstrate effective communication skills both oral and written and follow through on assigned tasks;

(D) demonstrate dependability and punctuality;

(E) demonstrate productive work habits and attitudes;

(F) understand the importance of taking pride in the quality of work performed;

(G) recognize the dignity in work;

(H) develop skill in planning and organizing work;

(I) apply required methods and sequences when performing tasks;

(J) apply principles of time management and work simplification when performing assigned tasks;

(K) identify ethical practices and responsibilities; and

(L) understand the importance of the application of organizational policies and procedures.

(3) Concepts and skills associated with entrepreneurship. The student shall be provided opportunities to:

(A) identify opportunities for business ownership;

(B) understand the risk and profit motive factor;

(C) understand the elements and advantages of the free enterprise system; and

(D) explain the role of small business in the free enterprise system.

(4) Concepts and skills related to safety and safe working conditions. The student shall be provided opportunities to identify and apply safe working practices to all training situations.

(5) Concepts and skills associated with human relations and personality development. The student shall be provided opportunities to:

(A) understand the importance of maintaining good health and proper appearance for effective job performance;

(B) understand oneself and others;

(C) exercise self-control;

(D) accept and use criticism;

(E) recognize basic human relationships as they relate to business success; and

(F) demonstrate characteristics for successful working relationships.

(6) Concepts and skills related to personal and business management. The student shall be provided opportunities to:

(A) explain how management assists in reaching personal and family goals;

(B) explain the management process;

(C) describe the role of management in controlling stress;

(D) identify and understand personal checking accounts;

(E) identify and understand personal loan application processes;

(F) identify and understand different financial institutions;

(G) identify the role and functions of business management;

(H) understand the lines of authority; and

(I) identify effective supervisory techniques.

(7) Concepts and skills related to supervised agricultural activities. The student shall be provided opportunities to plan and conduct/perform supervised agricultural activities.

Agricultural Science 282 - Exploring Aquaculture (½ unit) shall be a shop/laboratory-oriented course that includes the essential elements, concepts, and skills related to exploring aquaculture. The student shall be provided opportunities to:

(1) determine the nature of aquaculture;

(2) determine the origins of aquaculture;

(3) determine the biological principles, growth habits, anatomy, and morphology of aquacultural plants and animals;

(4) evaluate career opportunities in the aquaculture industry;

(5) understand water resource management;

(6) identify uses of water in aquacultural settings;

(7) identify methods of aquaculture production systems;

(8) understand aquabusiness planning and management;

(9) demonstrate leadership concepts and skills; and

(10) plan and conduct/perform supervised aquacultural activities.

## AGRISCIENCE 282 - EXPLORING AQUACULTURE

| Units and Topics of Instruction | Periods of Instruction | Essential Elements | Materials Teacher - Student |
|---|---|---|---|
| A. Explore the Nature and Significance of Aquaculture as a Viable Productive System | 3 | | |
| 1. Identify the Nature of Aquaculture Production | 1.5 | (1) | 8350-A |
| 2. Describe the Current Status and Potential for Aquaculture at the Local, State, National, and International Levels | 1.5 | (1) | 8350-B |
| B. Explore the Origins of Aquaculture as a Productive Enterprise | 2 | | |
| 1. Origins of Productive Aquaculture | 2 | (2) | 8351 |
| C. Identify Aquacultural Organisms and Their Importance | 6 | | |
| 1. Determine the Biological Principles of Aquacultural Species | 2 | (3) | 8352-A |
| 2. Determine the Growth of Aquatic Organisms | 2 | (3) | 8352-B |
| 3. Determine the Anatomy/Morphology of Aquatic Organisms | 2 | (3) | 8352-C |
| D. Explore Career Opportunities in Aquaculture | 2 | | |
| 1. Perform a Career Self-Analysis | .5 | (4) | 8353,1050,2902 9025,9029 |
| 2. Assess Career Decision-Making Skills | .5 | (4) | 8353,1050,2902 9025,9029 |
| 3. Evaluate Careers in Aquaculture | 1 | (4) | 8353,1050,2902 9025,9029 |
| E. Identify the Use of Water Resources in Aquaculture | 19 | | |
| 1. Determining the Properties of Water | 2 | (5,6) | 8354-A |
| 2. Qualities of Water for Aquaculture | 3 | (5,6) | 8354-B |
| 3. Obtaining Adequate Water Resources | 3 | (5,6) | 8354-C |
| 4. Managing Water Quality Factors | 5 | (5,6) | 8354-D |
| 5. Working with Aquaculture Water | 3 | (5,6) | 8354-E |
| 6. Disposing of Water | 3 | (5,6) | 8354-F |

| Units and Topics of Instruction | Periods of Instruction | Essential Elements | Materials Teacher - Student |
|---|---|---|---|
| F. Identify Methods of Aquaculture Production Systems | 39 | | |
| 1. Producing Seed Plants and Organisms | 6 | (7) | 8355-A |
| 2. Rearing Seed | 7 | (7) | 8355-B |
| 3. Growing Aquacrops | 3 | (7) | 8355-C |
| 4. Pond Planning | 6 | (7) | 8355-D |
| 5. Growing in Ponds | 3 | (7) | 8355-E |
| 6. Growing in Cages | 3 | (7) | 8355-F |
| 7. Growing in Tanks and Raceways | 3 | (7) | 8355-G |
| 8. Harvesting the Crop | 4 | (7) | 8355-H |
| 9. Processing the Crop | 2 | (7) | 8355-I |
| 10. Identify Personal Safety Measures | 2 | (7) | 8355-J |
| G. Identify Methods of Aquabusiness Planning and Management | 7 | | |
| 1. Managing the Aquafarm | 3 | (8) | 8356-A |
| 2. Marketing the Product | 4 | (8) | 8356-B |
| H. Plan and Conduct Leadership Activities Related to Aquaculture | 4 | | |
| 1. Develop Leadership Skills Related to Aquaculture Production | 2 | (9),(a)(1)(A-D) | 4850-4860 |
| 2. Participate in Leadership Activities Related to Aquaculture | 2 | (9),(a)(1)(A-D) | 8003,8004,8004a |
| I. Conduct Supervised Agricultural Experience Programs that Relate to Aquaculture | 2 | | |
| 1. Maintain Records Necessary to an Aquacultural Enterprise | 1 | (10) | 8001-8002b,8502 SAEP-J, 282-S,282-A |
| 2. Evaluate and Analyze Aquaculture Records | 1 | (10) | 8001-8002b,8502 SAEP-J, 282-S,282-A |

# AGRISCIENCE 282 - EXPLORING AQUACULTURE

**UNIT A: EXPLORE THE NATURE AND SIGNIFICANCE OF AQUACULTURE AS A VIABLE PRODUCTION SYSTEM**

**Topic 1: Aquacultural Production Systems**

**Topic Goal:**

The student shall be provided the opportunity to understand the meaning and practice of aquaculture.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. compare and contrast aquaculture with agriculture;
2. compare and contrast aquaculture with fisheries;
3. list two definitions of aquaculture and explain the differences in the two;
4. list examples of aquatic crops; and
5. list and describe the functions in aquaculture.

**Topic 2: Current Status and Potential for Aquaculture: Local, State, National, and International**

**Topic Goal:**

The student shall be provided the opportunity to explore the potential and status of aquaculture on the local, state, national, and international levels.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. discuss the potential for growth in the aquaculture industry;
2. identify sources to determine potential and status of local aquaculture;
3. identify sources to determine potential and status of state aquaculture;
4. identify sources to determine potential and status of national aquaculture; and
5. identify sources to determine potential and status of international aquaculture.

## UNIT B: EXPLORE THE ORIGINS OF AQUACULTURE AS A PRODUCTIVE ENTERPRISE

**Topic 1: Origins of Productive Aquaculture**

**Topic Goal:**

The student shall be provided the opportunity to explore the development of aquaculture on a worldwide scope and relate it to modern day aquacultural activities.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. compare the early development of aquaculture throughout the world;
2. identify some of the early systems of aquatic cultures;
3. list the countries with early aquacultural development;
4. explain a three dimensional aquacultural habitat;
5. identify the four major aquacultural species in current day production; and
6. specify three reasons for the expansion of aquaculture in the United States and throughout the world.

## UNIT C: IDENTIFY AQUACULTURAL ORGANISMS AND THEIR IMPORTANCE

**Topic 1: Biological Principles of Aquaculture Species**

**Topic Goal:**

The student shall be provided the opportunity to develop an understanding of the fundamentals of aquatic plant and animal biology.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. explain why aquatic crops may be more productive than terrestrial crops;
2. list and describe important characteristics in selecting a species; and
3. develop a file of information on aquaculture species.

**Topic 2: Growth of Aquatic Organisms**

**Topic Goal:**

The student shall be provided the opportunity to develop an understanding of the processes in maximizing growth rate of aquacrops.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. explain the importance of growth rate;
2. list and describe the major factors in the growth of aquatic fauna;
3. list and describe the major factors in the growth of aquatic flora; and
4. explain the concept of polyculture of flora and fauna.

**Topic 3: Anatomy/Morphology of Aquatic Organisms**

**Topic Goal:**

The student shall be provided the opportunity to understand that a key to successful aquaculture is knowing the anatomy of the target species.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. explain the meaning of the terms, anatomy and morphology;
2. identify and describe the basic structure and external anatomy of crustaceans;
3. identify and describe the basic structure and internal anatomy of an oyster or a mussel;
4. identify and describe the external and internal anatomy of fish; and
5. identify and describe the basic morphology of aquatic macro and micro algae.

## UNIT D: EXPLORE CAREER OPPORTUNITIES IN AQUACULTURE

**Topic 1: Exploring Occupations in Aquaculture**

**Topic Goal:**

The student shall be provided the opportunity to evaluate occupational opportunities in the aquaculture industry.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. identify occupational opportunities in aquaculture supplies and services areas;
2. identify occupational opportunities in aquaculture production;
3. identify occupational opportunities in aquaculture marketing;
4. identify occupational opportunities in aquaculture research and development;
5. compare and contrast educational requirements for occupations in the aquaculture industry; and
6. identify the opportunities available to gain experience and training necessary to enter the aquaculture industry.

## UNIT E: IDENTIFY THE USE OF WATER RESOURCES IN AQUACULTURE

**Topic 1: Properties of Water**

**Topic Goal:**

The student shall be provided the opportunity to understand the importance, unique properties, and contents of water, particularly as related to aquaculture.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. explain why water is important in aquaculture;
2. describe the properties of water; and
3. describe solutions and suspensions.

**Topic 2: Qualities of Water for Aquaculture**

**Topic Goal:**

The student shall be provided the opportunity to understand the qualities of aquatic solutions and the affects of changes on aquatic life.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. explain the qualities of water for aquaculture;
2. describe why and how aquatic solutions change; and
3. explain how changes in water effect aquatic life.

**Topic 3: Obtaining Adequate Water Resources**

**Topic Goal:**

The student shall be provided the opportunity to develop an understanding of the sources of water, how they differ, and how to locate water for aquaculture.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. list the sources of water;
2. describe the qualities of the water from different sources;
3. explain ways of locating these sources; and
4. describe considerations in selecting a source.

**Topic 4: Managing Water Quality Factors**

**Topic Goal:**

The student shall be provided the opportunity to develop the skills in managing water in aquaculture including water quality.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. explain water quality factors in aquaculture systems;
2. conduct water quality tests;
3. use test results in determining suitability of water; and
4. explain how water quality is maintained.

**Topic 5: Working with Aquacultural Water**

**Topic Goal:**

The student shall be provided the opportunity to develop the skills of managing water in aquaculture which includes methods of moving water, how to measure water, and how to maintain water quality.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. describe four methods of moving water;
2. calculate volume in a circular water structure;
3. calculate volume in a rectangular water structure;
4. calculate volume in a irregular-shaped water structure; and
5. calculate volume of a pond with sloped banks.

**Topic 6: Disposing of Water**

**Topic Goal:**

The student shall be provided the opportunity to develop the competencies in disposing of wastewater including appropriate attitudes toward water disposal as well as pollution, techniques of treatment, and regulations in water disposal.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. list and explain sources of aquaculture pollution;
2. describe sources of wastewater in aquafarming;
3. explain why aquafarmers should be concerned about water disposal;
4. list and describe six sources of wastewater pollution;
5. describe how pollution from aquaculture affects the environment;
6. explain ways to dispose wastewater; and
7. identify regulations that apply to wastewater disposal.

**UNIT F: IDENTIFY METHODS OF PRODUCTION IN WATER**

**Topic 1: Producing Seed Plants and Organisms**

**Topic Goal:**

The student shall be provided the opportunity to develop the competencies in producing seed.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. describe the purpose and functions of a hatchery;
2. describe ways seed are produced;
3. explain environment factors in a hatchery;
4. describe the sexual reproduction processes of aquaculture organisms;
5. describe procedures in reproducing aquaculture organisms;
6. describe the spawning facilities used in aquaculture; and
7. select a method of producing seed for an aquafarm.

**Topic 2: Rearing Seed**

**Topic Goal:**

The student shall be provided the opportunity to develop the competencies of rearing seed in a hatchery or nursery.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. explain how to hatch seed in different incubators;
2. describe how to feed young seed;
3. describe the kind of feed to use;
4. identify ways of feeding in the hatchery;
5 explain how to grade seed; and
6. describe how to transport seed.

**Topic 3: Growing Aquacrops**

**Topic Goal:**

The student shall be provided the opportunity to develop the competencies of the "growing out" fish.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. identify factors to consider in determining whether to grow fish;
2. describe the facilities used in growout operations;
3. explain important environment factors; and
4. describe where seed can be obtained.

**Topic 4: Pond Planning**

**Topic Goal:**

The student shall be provided the opportunity to develop the competencies in using ponds to grow aquacrops, primarily fish. The different types of ponds and construction features are included.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. distinguish between three types of ponds;
2. identify factors in pond site selection; and
3. explain important pond construction requirements.

**Topic 5: Growing In Ponds**

**Topic Goal:**

The student shall be provided the opportunity to develop the competencies in using ponds to grow aquacrops, primarily fish. Instruction will include aeration and species that are adapted to ponds.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. select species for pond culture;
2. describe feeding methods used with ponds; and
3. describe oxygen management in ponds.

**Topic 6: Growing In Cages**

**Topic Goal:**

The student shall be provided the opportunity to develop the competencies in growing aquacrops in cages. This will involve a study of cage site location, cage design, placing cages, selecting species for cage culture, and feeding in cages.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. define cage culture;
2. list advantages and disadvantages of cage culture;
3. describe design requirements of cages;
4. select species for growing in cages;
5. specify criteria to consider in site selection; and
6. describe how to feed in cages.

**Topic 7: Growing In Tanks And Raceways**

**Topic Goal:**

The student shall be provided the opportunity to develop the competencies in producing aquacrops in tanks and raceways. The instruction will include kinds of tanks, tank design, species suitable for tank culture, water requirements, and feeding the aquacrop.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. define tank and raceway culture;
2. list advantages and disadvantages of tank and raceway culture;
3. describe design requirements of tanks and raceways;
4. select species for tank and raceway culture;
5. describe water management; and
6. explain how to feed crops in tanks and raceways.

**Topic 8: Harvesting The Crop**

**Topic Goal:**

The student shall be provided the opportunity to develop fundamental competencies in harvesting aquacrops.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. define harvesting;
2. describe types of harvests;
3. explain methods of harvesting; and
4. describe how to store aquacrops.

**Topic 9: Processing the Crop**

**Topic Goal:**

The student shall be provided the opportunity to develop basic knowledge of the role of processing in the production of aquacrops.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. describe the role of processing;
2. explain basic processing procedures;
3. describe forms of preparation;
4. define dressing percentage and explain its importance;
5. describe the role of the farmer in processing; and
6. explain quality control regulations.

**Topic 10: Personal Safety Measures**

**Topic Goal:**

The student shall be provided the opportunity to develop an awareness of the safety practices and concerns throughout the aquaculture industry.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. discuss safety when working around water;
2. discuss safety when working with facilities construction;
3. discuss safety when operating tractors in an aquaculture area;
4. discuss safety when working with aquaculture production;
5. discuss safety when working around harvesting equipment;
6. discuss safety when hauling an aquacrop;
7. discuss safety when working in an aquaculture processing facility;
8. discuss the health concerns when working in the aquaculture industry; and
9. discuss the need and concern for safety that involves aquatic wildlife.

## UNIT G: IDENTIFY METHODS OF AQUABUSINESS PLANNING AND MANAGEMENT

**Topic 1: Managing the Aquafarm**

**Topic Goal:**

The student shall be provided the opportunity to develop competencies in the management processes that are important with aquafarms.

**Topic Objectives:**

After completing the topic, students shall be able to:

1. define related management terms;
2. describe functions in the management process;
3. identify management considerations in planning an aquabusiness;
4. explain important skills of managers;
5. describe the importance of records and reports; and
6. explain important human relations skills.

**Topic 2: Marketing the Product**

**Topic Goal:**

The student shall be provided the opportunity to develop an understanding of the meaning of marketing and the functions that are involved.

**Topic Objectives:**

After completing the topic, the student shall be able to:

1. define marketing;
2. explain the elements in developing a marketing strategy;
3. describe the functions in the process of marketing aquacrops;
4. explain the importance of developing a marketing plan;
5. identify possible market outlets for aquacrops;
6. select an appropriate market;
7. explain costs in marketing; and
8. describe the role of market promotion in aquaculture.

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